Please type a plus sign (+) inside this box [+]

PTO/SB/05 (12/97)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 082771.P277 Total Pages 2

First Named Inventor or Application Identifier Shantigram Jagannath, et al.

Express Mail Label No. EL034145171US

ADDRESS TO:	**Assistant Commissioner for Patents** **Box Patent Application** **Washington, D. C. 20231**

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
   (Submit an original, and a duplicate for fee processing)

2. X Specification (Total Pages 15)
   (preferred arrangement set forth below)
   - Descriptive Title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claims
   - Abstract of the Disclosure

3. X Drawings(s) (35 USC 113) (Total Sheets 7)

4. X Oath or Declaration (Total Pages 4) (unsigned)
   a. ___ Newly Executed (Original or Copy)
   b. ___ Copy from a Prior Application (37 CFR 1.63(d))
   (for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**
   i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ___ Incorporation By Reference (useable if Box 4b is checked)
   The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ___ Microfiche Computer Program (Appendix)

7. __ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
a. ____ Computer Readable Copy
b. ____ Paper Copy (identical to computer copy)
c. ____ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. __ Assignment Papers (cover sheet & documents(s))
9. __ a. 37 CFR 3.73(b) Statement (where there is an assignee)
__ b. Power of Attorney
10. __ English Translation Document (if applicable)
11. __ a. Information Disclosure Statement (IDS)/PTO-1449
__ b. Copies of IDS Citations
12. __ Preliminary Amendment
13. __ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. __ a. Small Entity Statement(s)
b. Statement filed in prior application, Status still proper and desired
15. __ Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. __ Other: _____

17. **If a CONTINUING APPLICATION,** check appropriate box and supply the requisite information:
____ Continuation ____ Divisional ____ Continuation-in-part (CIP)
of prior application No: _

18. **Correspondence Address**
_____ Customer Number or Bar Code Label _____
(Insert Customer No. or Attach Bar Code Label here)
or
__X__ Correspondence Address Below

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FEE TRANSMITTAL

TOTAL AMOUNT OF PAYMENT ($) 960.00

Complete if Known:
Application No. _____
Filing Date _____
First Named Inventor Shantigram Jagannath, et al.
Group Art Unit _____
Examiner Name _____
Attorney Docket No. 082771.P277 Express Mail No.: EL034145171US

METHOD OF PAYMENT (check one)

1. [X] **The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:**

   Deposit Account Number 02-2666
   Deposit Account Name _____

   [ ] **Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17**

   [ ] **Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance, 37 CFR 1.131(b)**

2. X **Payment Enclosed**
   X **Check**
   __ **Money Order**
   __ **Other**

FEE CALCULATION (fees effective 10/01/97)

1. **FILING FEE**

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	790	201	395	Utility application filing fee	790.00
106	330	206	165	Design application filing fee	
107	540	207	270	Plant filing fee	
108	790	208	395	Reissue filing fee	
114	150	214	75	Provisional application filing fee	

SUBTOTAL (1) $ 790.00

2. **CLAIMS**

			Extra		Fee from below		Fee Paid
Total Claims	24	- 20 =	4	X	22.00	=	88.00
Independent Claims	4	- 3 =	1	X	82.00	=	82.00
Multiple Dependent Claims			__	X	____	=	____

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
103	22	203	11	Claims in excess of twenty	88.00
102	82	202	41	Independent claims in excess of 3	82.00
104	270	204	135	Multiple dependent claim	
109	82	209	41	Reissue independent claims over original patent	
110	22	210	11	Reissue claims in excess of 20 and over original patent	

SUBTOTAL (2) $ 170.00

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	400	216	200	Extension for response within second month	
117	950	217	475	Extension for response within third month	
118	1,510	218	755	Extension for response within fourth month	
128	2,060	228	1,030	Extension for response within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive unavoidably abandoned application	
141	1,320	241	660	Petition to revive unintentionally abandoned application	
142	1,320	242	660	Utility issue fee (or reissue)	
143	450	243	225	Design issue fee	
144	670	244	335	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	790	246	395	For filing a submission after final rejection (see 37 CFR 1.129(a))	
149	790	249	395	For each additional invention to be examined (see 37 CFR 1.129(a))	
Other fee (specify)					
Other fee (specify)					

SUBTOTAL (3) $ 0

*Reduced by Basic Filing Fee Paid

SUBMITTED BY:

Typed or Printed Name: David R. Halvorson

Signature _____ **Date** 6/30/98

Reg. Number 33,395 **Deposit Account User ID** _____ (complete if applicable)

PTO/SB/17 (10-96)
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82771.P277

UNITED STATES PATENT APPLICATION

FOR

METHOD AND APPARATUS FOR VIRTUAL OVERLAY NETWORKS

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BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to the field of networking and more specifically to virtual overlay networks (VONs) and virtual private networks (VPNs).

2. DESCRIPTION OF THE RELATED ART

Virtual private networks (VPNs) allow users to appear to be on the same private network although there may be many (usually public) networks in between the users. Figure 1A illustrates the logical appearance to users of a virtual private network . Figure 1B illustrates a high level view of the actual network configuration.

Packets destined from one user (say in Chicago in the illustration of Figure 1B) to another user (say in Boston in the illustration of Figure 1B) may be transmitted through an internet service provider (ISP) which supports VPNs. Each site connected to the ISP network advertises to the ISP a set of destinations reachable within the site. The ISP then redistributes this information to all other sites in the set of sites which form the VPN. This process is further described in Heinanen, et al., VPN support with MPLS, Internet Draft, draft-heinanen-mpls-vpn-01.txt, March 1998.

Since the ISP may support multiple VPNs, and since these VPNs may use private address spaces (and, thus the addresses spaces may be non-unique), the routing system within the ISP needs to be able to unambiguously differentiate reachability information (i.e., private address space information)

for the various VPNs. Heinanen, et al describes that this may be accomplished by having the ISP assign each VPN its own VPN identifier (VPN-ID) and having the routing system use a combination of the VPN-ID and the reachability information provided by the sites for routing. In such a system, a single routing system may support multiple VPNs whose address spaces overlap with each other.

Figure 2 illustrates an exemplary prior art routing system using VPN-IDs and reachability information provided by the sites for routing. As illustrated by Figure 2, a packet to be routed may include a virtual private network identifier (VPN-ID) 201, reachability information (e.g., private addressing information) 202, an internet protocol (IP) header 203 and payload information 204. A single route table 206 is maintained and is indexed by the combination of the VPN-ID 201 and the reachability information 202.

As is shown in Figure 2, prior art solutions provide a flat address routing space by simply combining the VPN-ID with the reachability information provided by the sites.

It would be useful to provide more fine-grained control over the routed topology for individual VPNs.

SUMMARY OF THE INVENTION

A method and apparatus for directing messages through a network wherein multiple tables for directing messages through the network are maintained and provided. Each table corresponds to a virtual private network and contains routing information specific to that virtual private network. A separate routing table is maintained for each virtual private network. In one embodiment the messages are forwarded using plain IP forwarding, based on a route table corresponding to the virtual private network. In another embodiment separate forwarding tables using labels are generated for each virtual private network. In a third embodiment, a single forwarding table is utilized where the forwarding table is created based on separate routing tables for each virtual private network.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A illustrates a logical representation of a virtual private network.

Figure 1B illustrates a high level conceptual representation of virtual private network.

Figure 2 illustrates a prior art packet / routing table arrangement.

Figure 3A illustrates a first embodiment of a packet / routing table arrangement as may be implemented by the present invention.

Figure 3B illustrates a second embodiment of a packet / routing table arrangement as may be implemented by the present invention.

Figure 3C illustrates a third embodiment of a packet / routing table arrangement as may be implemented by the present invention.

Figure 4 is a high level diagram illustrating a network as may implement the present invention.

For ease of reference, it might be pointed out that reference numerals in all of the accompanying drawings typically are in the form "drawing number" followed by two digits, xx; for example, reference numerals on Figure 1 may be numbered 1xx; on Figure 3, reference numerals may be numbered 3xx. In certain cases, a reference numeral may be introduced on one drawing and the same reference numeral may be utilized on other drawings to refer to the same item.

DETAILED DESCRIPTION OF THE EMBODIMENTS THE PRESENT INVENTION

As was discussed above, Virtual private networks (VPNs) allow users to appear to be on the same private network although there may be many (usually public) networks in between the users.

Packets destined from one to another user may be transmitted through an internet service provider (ISP) which supports VPNs. Each site connected to the ISP network advertises to the ISP a set of destinations reachable within the site. The ISP then redistributes this information to all other sites in the set of sites which form the VPN. Since the ISP may support multiple VPNs, and since these VPNs may use private address spaces (and, thus the addresses spaces may be non-unique), the routing system within the ISP needs to be able to unambiguously differentiate reachability information (i.e., private address space information) for the various VPNs.

A similar issue regarding need to unambiguously differentiate reachability information exists with Virtual Overlay Networks (VONs). VONs provide the capability to build logical independent networks over a shared public network infrastructure. VONs are particularly attractive to bandwidth and network infrastructure wholesalers and can also benefit both ISPs and private enterprise networks. VONs allow logical partitioning of networks without building expensive filtering mechanisms. For example, multiple small ISPs could share the same network infrastructure (consisting of, e.g., high bandwidth links and high end router devices) while each ISP could be provisioned to offer specific and tailored services (e.g., real time multicast service) to targeted customers. The concept could also be applied in the

context of a single ISP when it sells services to different private customers. Each ISP could have a routed topology that is optimized for its needs – it will only use those nodes and those links that it requires to provide services. This logical separation allows a single high bandwidth network infrastructure with high bandwidth routers to be shared by many small ISPs offering specialized services. Alternatively it allows a single ISP to partition its network into nodes and links that are used for specialized services and those that are used to carry primarily best effort traffic.

In the present invention such logically separated routed topologies are maintained for eachVPN. A packet belonging to a VPN is identified by its VPN-ID. The VPN-ID is placed in the label field as defined by the Multi-protocol label switching standard, see, Callon et al., A Framework for Multiprotocol Label Switching, draft-ietf-mpls-framework-02.txt, November, 1997. (Callon et.al). In one embodiment, the VPN-ID is not used for forwarding, but merely identifies a routing table belonging to a particular VPN. In this embodiment the packet is forwarded by doing a standard IP destination address look-up on the table identified by the VPN-ID. In another embodiment, the VPN-ID identifies an MPLS forwarding table corresponding to the VPN where the MPLS forwarding table is built based on the routing table corresponding to the VPN. In a third embodiment, the VPN-ID is a part of the MPLS forwarding label. A single MPLS forwarding table is built based on a separate route table for each VPN and the forwarding is done by looking up the MPLS label (comprising of the VPN-ID part and a forwarding label part) in the forwarding table.

This approach of providing a logically separated routed topology for each VPN offers significant advantages over prior art approaches. Utilizing this approach, an ISP may, for example:

1. choose which links and nodes are in a given VPN;
2. assign a given link different administrative weights for different VPNs; and
3. allocate different service levels/guarantees for different VPNs or provisions the service levels and guarantees differently.
4. use different routing protocols for the different VPNs
5. completely isolate the traffic of one VPN from another.

Multi Protocol Label Switching (MPLS) is used on the data plane in certain embodiments of the present invention. MPLS is described in greater detail in Callon et al.,. MPLS is intended to simplify the forwarding function of routing devices by introducing a connection-oriented mechanism inside the otherwise connectionless IP technology. A label switched path (LSP) is set up for each route. Edge routers analyze the traditional IP header (such as IP header 203) to decide which LSP to use and add a corresponding label switched path identifier in the form of a label (such as is show in Figure 3A as VPN-ID 201, in Figure 3B as VPN-ID 201 and forwarding label 302 and in Figure 3C as VPN-ID/forwarding label 311.

As will be described, MPLS may be used to facilitate implementation of logically separated VPNs.

Figure 4 provides a high level overview of a network as may implement the present invention. An edge router (such as router 401, 402 or 403) which resides at the enterprise or alternatively, at the ISP's site. The edge router 401-3 classifies packets onto a given VPN. The packet-to-VPN classification

may be based on standard filtering techniques (e.g., input port and IP header mask). The edge router 401-403 then applies a VPN-specific label to the packet so that it can be routed by the backbone routers 411-413 in the wide area network cloud.

Three alternative approaches for providing logically separated routed topologies are described in connection with Figures 3A-C.

Turning first to Figure 3A, the label (e.g., VPN-ID 201) is used to identify a routing table 304 or 305. The packet is then routed based on the reachability information in the IP header 203. In this embodiment, no label distribution protocol (e.g. MPLS) is required.

Figure 3B illustrates an approach utilizing a label stack comprising the VPN-ID 201 and a forwarding label 302. In this embodiment, the VPN-ID 201 indicates an MPLS forwarding table 308, 309 which corresponds to the VPN-ID. The forwarding label 302 provides MPLS label switching information. By utilizing this embodiment, multiple instances of the standard MPLS distribution protocol can be utilized.

Finally, turning to Figure 3C, each router is allowed to manage its own MPLS flat label space. Each router is responsible for keeping track of which VPN each label refers to and for routing them accordingly. The router locally builds the labels based on its route tables and VPN-ID information and stores them in a single MPLS forwarding table 312. In this embodiment, the router still maintains separate route tables for each VPN. In the described embodiment, as illustrated by Figure 3C, this is accomplished by extending the label distribution protocol to carry a VPN-ID with the forwarding label as a combined VPN-ID/forwarding label 311.

Thus, what has been disclosed a method and apparatus for maintaining logically separate routing topologies based on virtual private networks.

CLAIMS

What is claimed is:

1. A router comprising:
   a) a first port for receiving a packet having a label, a header and a payload;
   b) a table associated with the label; and
   c) a processor for processing the packet in accordance with the table.

2. The router as recited by claim 1 wherein in the table is a route table.

3. The router as recited by claim 1 wherein the table is a forwarding table.

4. The router as recited by claim 1 wherein the label identifies a virtual private network.

5. The router as recited by claim 1 further having a second port for transmitting said packet.

6. The router as recited by claim 1 wherein the header is an internet protocol header.

7. The router as recited by claim 1 wherein the label comprising information identifying a virtual private network and a forwarding label.

8. A method of routing in a network comprising:

   a) maintaining a first table corresponding to a first virtual private network;

   b) maintaining a second table corresponding to a second virtual private network;

   c) routing a packet based on the first table or the second table

9. The method as recited by claim 8 wherein the first table and the second table are route tables.

10. The method as recited by claim 8 wherein the first table and the second table are forwarding tables

11. The method as recited by claim 9 further comprising the step of maintaining forwarding table indexable by a virtual private network identifier.

12. The method as recited by claim 8 wherein the packet comprises a label, a header and a payload.

13. The method as recited by claim 8 wherein the label comprises information identifying a virtual private network.

14. The method as recited by claim 8 wherein the label comprises information identifying a virtual private network and a forwarding label.

15. The method as recited by claim 9 wherein the first table or the second route table is chosen for routing the packet based on the label.

16. A method of routing in a network comprising:
    a) maintaining a first forwarding table corresponding to a first virtual private network;
    b) maintaining a second forwarding table corresponding to a second virtual private network;
    c) routing a packet based on the first forwarding table or the forwarding table

17. The method as recited by claim 16 wherein the packet comprises a label, a header and a payload.

18. The method as recited by claim 16 wherein the label comprises information identifying a virtual private network.

19. The method as recited by claim 16 wherein the label comprises information identifying a virtual private network and a forwarding label.

20. The method as recited by claim 16 wherein the first table or the second table is chosen for routing the packet based on the label.

21. A network comprising:
    a) a first edge router coupled to receive a packet having a first header and a second header and to transmit into a wide area

network cloud a modified packet having a label, the first header and the second header;

b) a backbone router coupled to receive the modified packet and route the modified packet based on a route table associated with the label; and

c) a second edge router coupled to receive the modified packet.

22. The network as recited by claim 21 wherein the label comprises information identifying a virtual private network.

23. The network as recited by claim 21 wherein the label comprises information identifying a virtual private network and a forwarding label.

24. The network as recited by claim 21 wherein the backbone router comprises a second route table.

ABSTRACT OF THE DISCLOSURE

A method and apparatus for directing messages through a network wherein multiple tables for directing messages through the network are maintained and provided. Each table corresponds to a virtual private network and contains routing information specific to that virtual private network. A separate routing table is maintained for each VPN. In one embodiment the messages are forwarded using plain IP forwarding using a route table associated with the VPN. In another embodiment separate forwarding tables using labels are generated for each virtual private network. The messages are forwarded by looking up the label in the table corresponding to the VPN In a third embodiment, a single forwarding table is utilized where the table is built based on separate routing tables for each virtual private network.

Virtual Private Network as it appears to users.

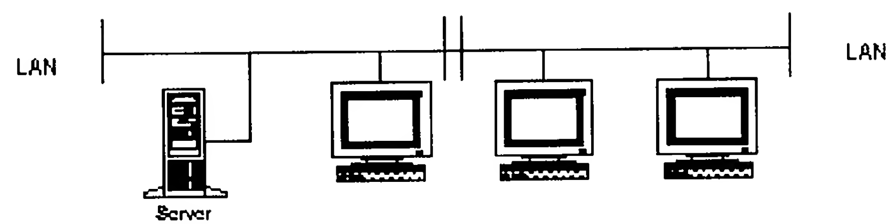

FIGURE 1A

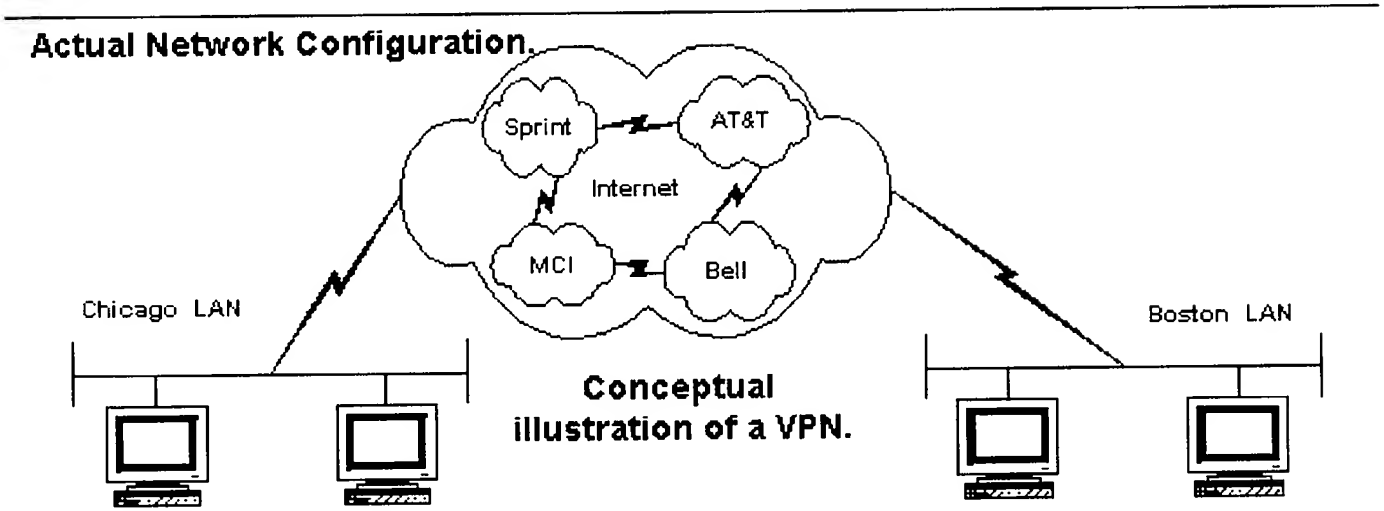
Actual Network Configuration.
Sprint
AT&T
Internet
MCI
Bell
Chicago LAN
Boston LAN
Conceptual
illustration of a VPN.

FIGURE 1B

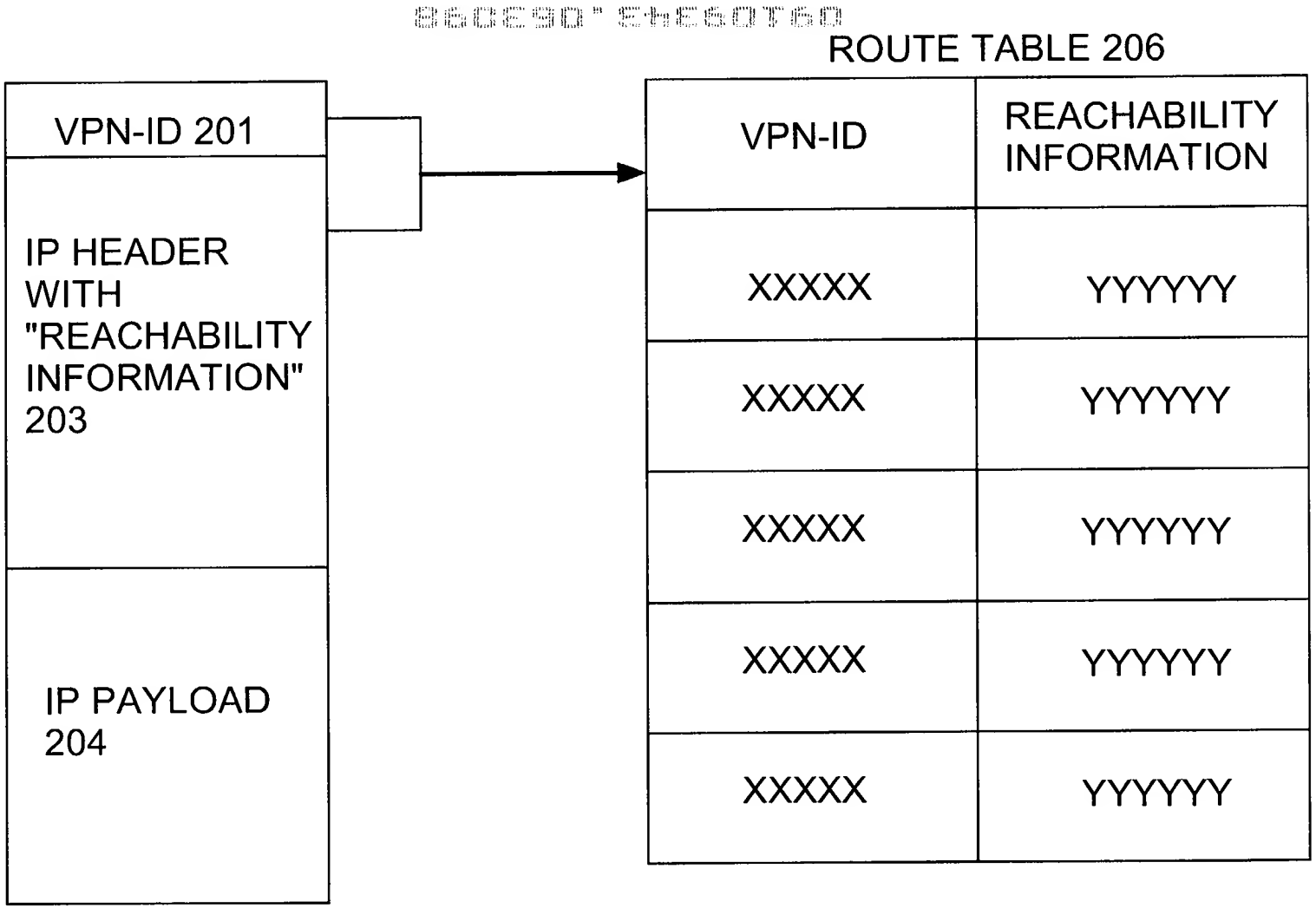
VPN-ID 201
IP HEADER WITH "REACHABILITY INFORMATION" 203
IP PAYLOAD 204
ROUTE TABLE 206
VPN-ID
REACHABILITY INFORMATION
XXXXX
YYYYYY
XXXXX
YYYYYY
XXXXX
YYYYYY
XXXXX
YYYYYY
XXXXX
YYYYYY

FIGURE 2

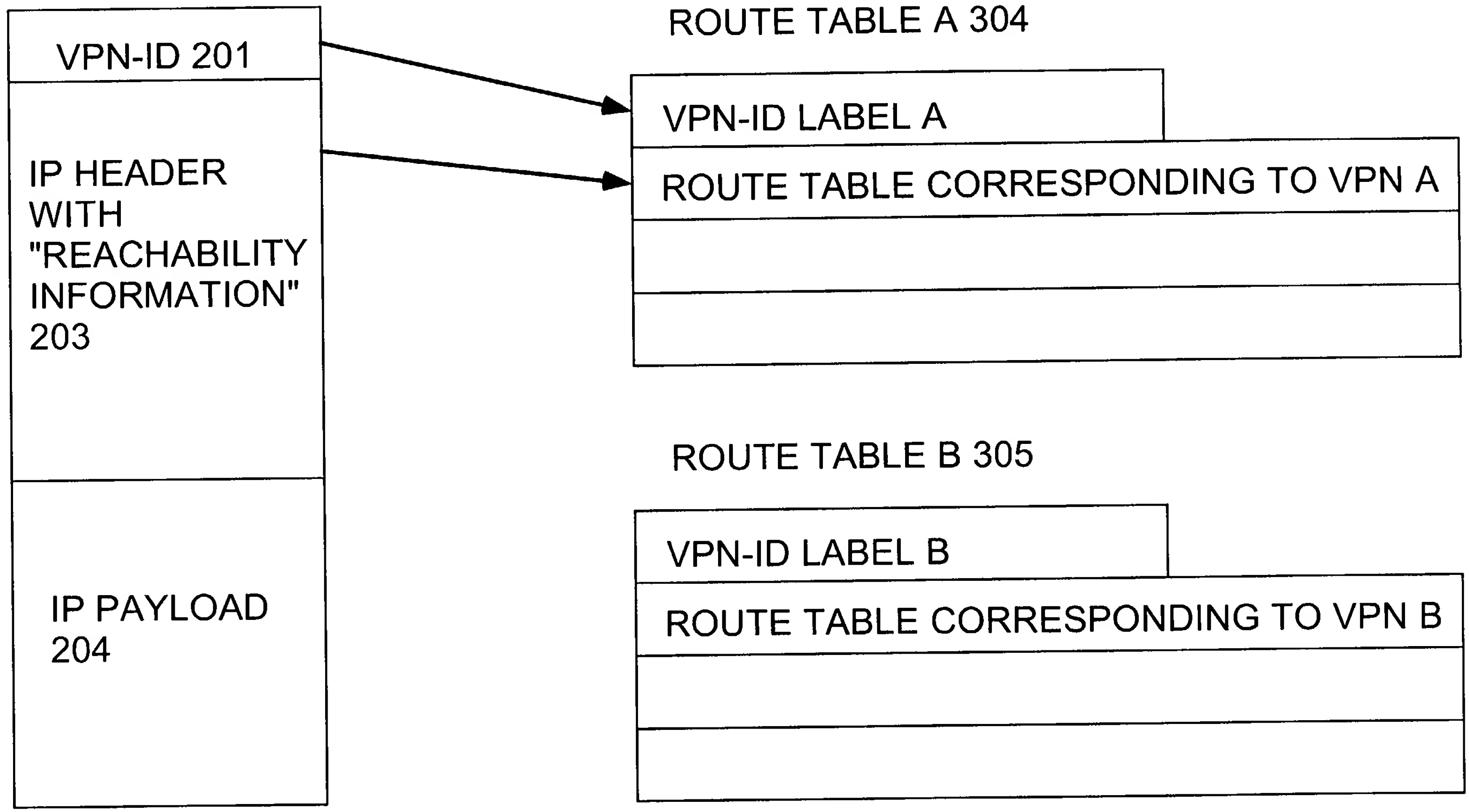
VPN-ID 201
IP HEADER WITH "REACHABILITY INFORMATION" 203
IP PAYLOAD 204
ROUTE TABLE A 304
VPN-ID LABEL A
ROUTE TABLE CORRESPONDING TO VPN A
ROUTE TABLE B 305
VPN-ID LABEL B
ROUTE TABLE CORRESPONDING TO VPN B

FIGURE 3A

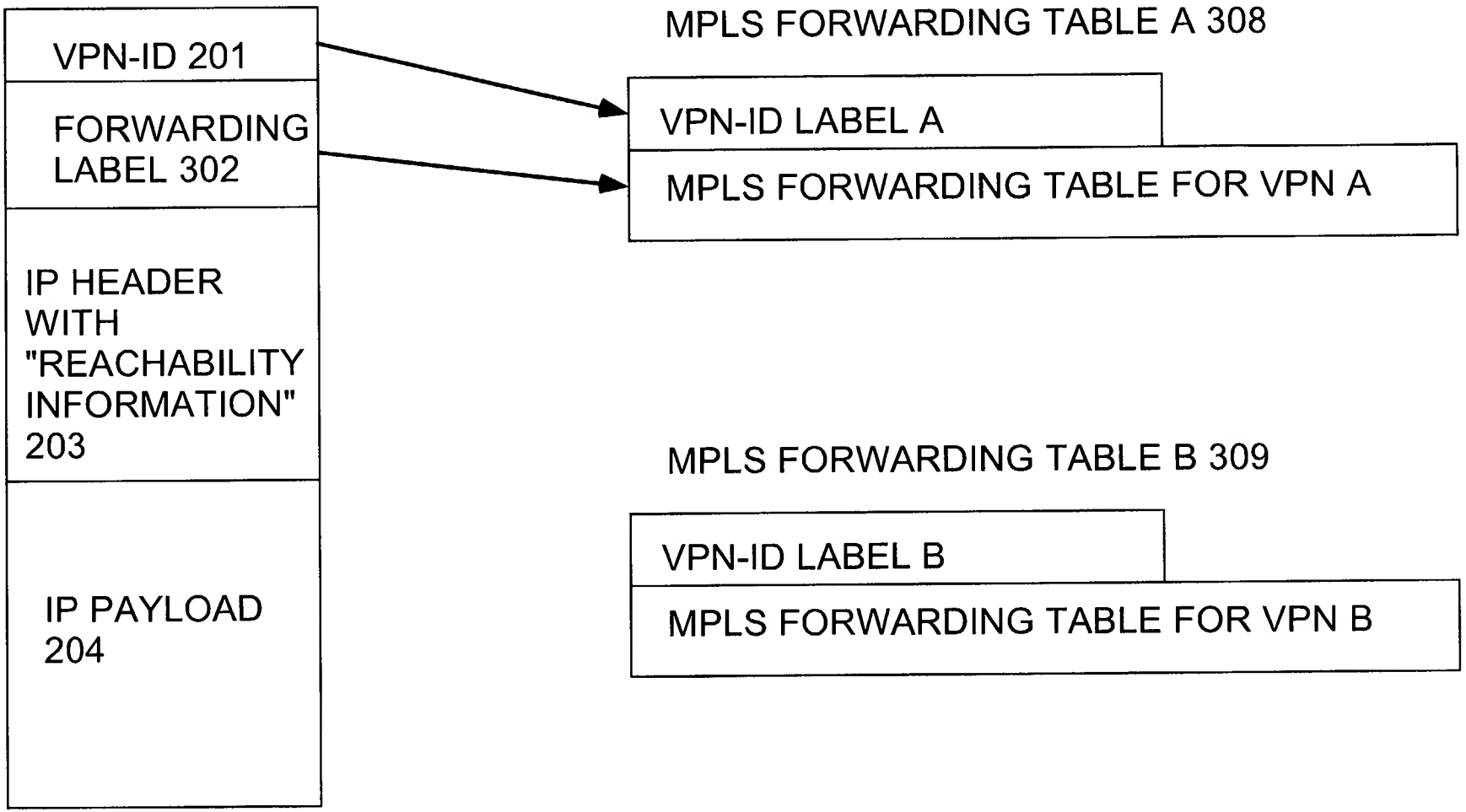

FIGURE 3B

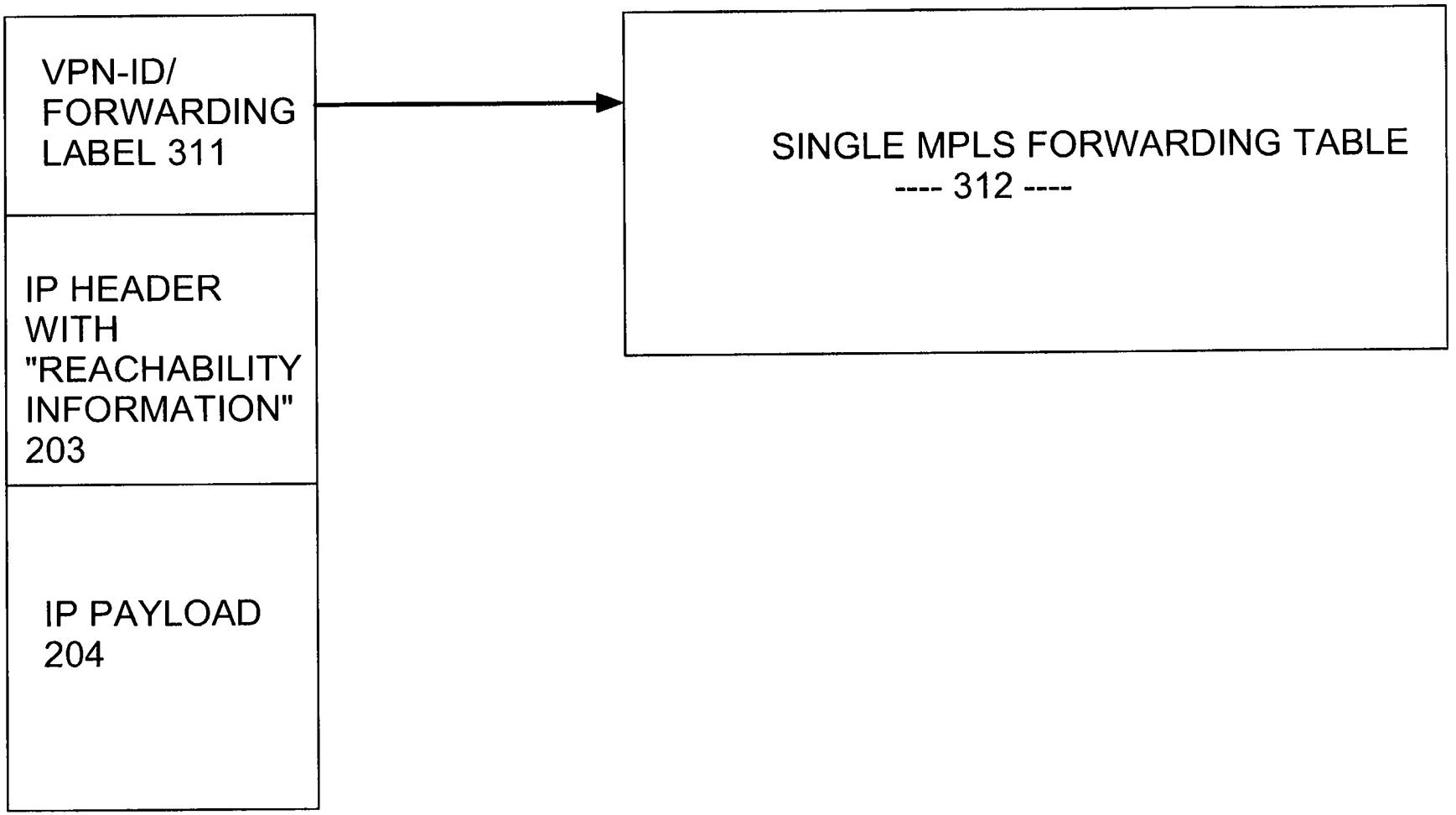
VPN-ID/
FORWARDING
LABEL 311
IP HEADER
WITH
"REACHABILITY
INFORMATION"
203
IP PAYLOAD
204
SINGLE MPLS FORWARDING TABLE
---- 312 ----

FIGURE 3C

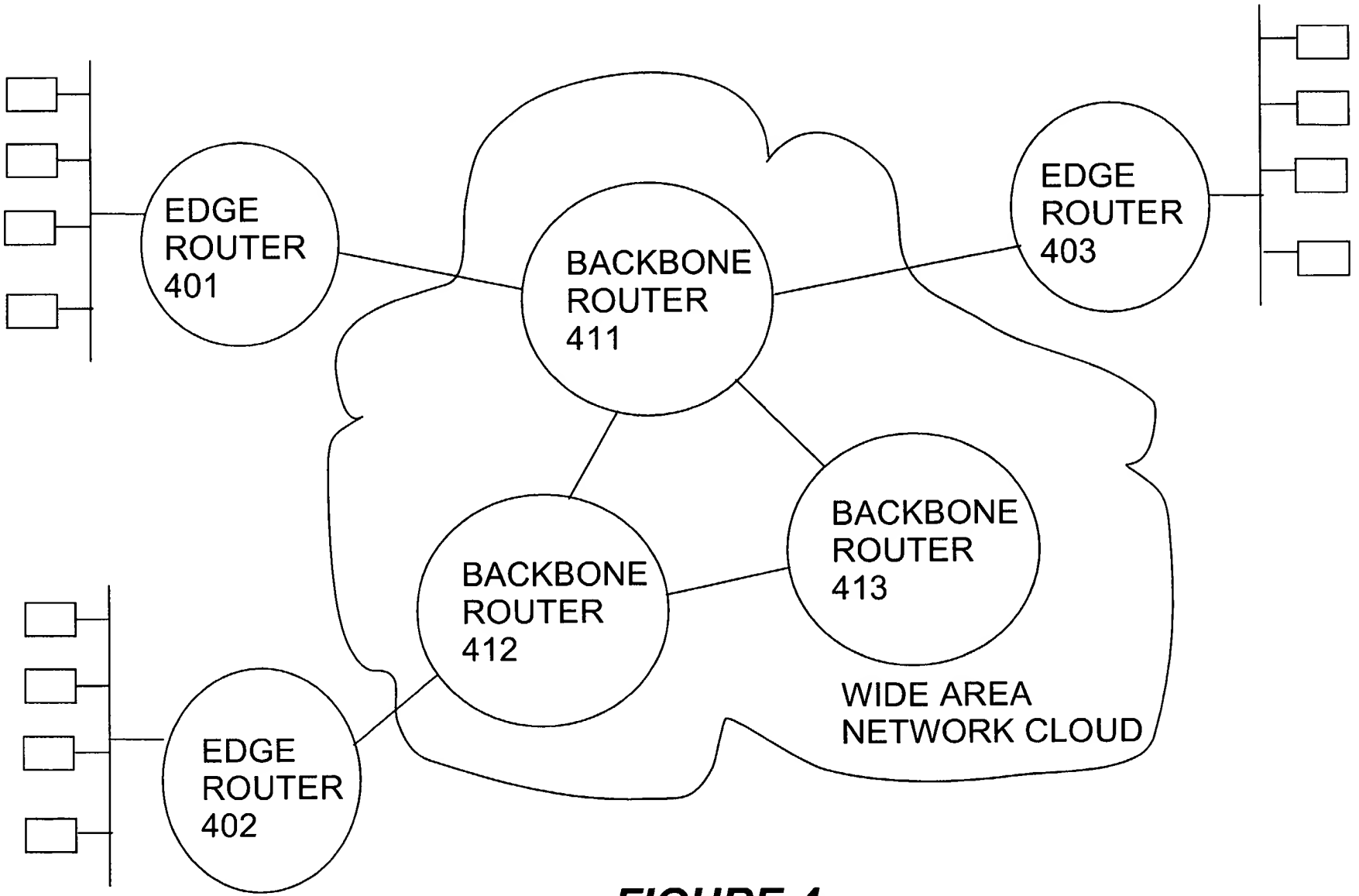

FIGURE 4

Attorney's Docket No.: 082771.P277 PATENT

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Method and Apparatus for Virtual Overlay Networks

the specification of which

_x_ is attached hereto.
___ was filed on _____ as
United States Application Number _____
or PCT International Application Number_____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

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Send correspondence to David R. Halvorson, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to David R. Halvorson, (408) 720-8598 x301.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.